SimonXXL - Investigating Spontaneous Group Formation around Public Installations

Jacobsen, Bo; Utne Kærholm Svendsen, Michael; Kjær Søgaard, Adam; Lundegaard Uggerhøj, Rune; Löchtefeld, Markus

Published in:
Interactivity, Game Creation, Design, Learning, and Innovation

DOI (link to publication from Publisher):
10.1007/978-3-030-53294-9_37

Publication date:
2020

Document Version
Early version, also known as pre-print

SimonXXL - Investigating Spontaneous Group Formation around Public Installations

Bo Jacobsen, Michael Utne Kærholm Svendsen, Adam Kjær Søgaard, Rune Lundegaard Uggerhøj, Markus Löchtefeld

Aalborg University, Aalborg, Denmark
bjacob93@outlook.com, micuks1@gmail.com, adam.soegaard@gmail.com, rune.lundegaard@gmail.com & mloc@create.aau.dk

Abstract. In this paper, we set out to explore how to design for spontaneous group formation, as part of shared encounters in a public installation. Spontaneous group formation describes a phenomenon where pedestrians form groups with other pedestrians, to whom they are previously unacquainted, for the purpose of interacting with an installation. This was accomplished by developing a 5 by 5 meter version of the game based on the *Simon* game, with flashing lights and oversized buttons, designed to encourage spontaneous group formation by giving an advantage to larger groups, up to a maximum of four. Over three days of testing, the prototype was found to generate 11 spontaneous group formations out of 161 total use cases, showing evidence that effective lures are one of the key factors behind the phenomenon.

Keywords: Public Installation · Public Games · Spontaneous Group Formation · Playable Cities.

1 Introduction

Playable City – a subcategory of Smart Cities – has recently been a major focus not only of urban designers and city planners but also for computer scientists and a variety of other researchers [16]. It revolves around increasing the quality of life of citizens through technological implementations that facilitate play and relaxation, rather than focusing on optimization through Big Data as it is often the case with Smart City approaches. This goal can be achieved through several means, for example the implementation of interactive media facades [2,6] or more playful exhibits [7,10,12,14]. Other installations are more akin to gaming, such as [4], and this is where the focus of this paper lies.

Many games could be fashioned to work towards the common goal of a playable city, as many games are fun, easy to pick up and quick to play. However, a feature that is common in games is the possibility—and sometimes even requirement—for multiple players, which reveals a problem: if a pedestrian is walking by themselves, they might be excluded from benefiting from the assumed quality of life boost that a game as an urban installation would supply. This immediately presents the question of how one could inspire pedestrians to

spontaneously form groups, and engage with people to whom they were previously unacquainted.

That is what this paper sets out to investigate. Specifically we are interested in the different factors that are responsible for triggering what we title *Spontaneous Group Formation* (SGF) in a public setting. We approach SGF as a sub-category of Shared Encounters [20], in which not only prior unrelated users spontaneously form a group, and have a performative co-presence, but they also try to achieve a common goal that requires cooperation. Therefore we set up a public installation – a game aiming to motivate users to cooperate – in three different situations that were moderately to heavily foot-trafficked areas. To achieve this goal, several criteria had to be fulfilled in order to successfully facilitate SGF. Firstly, it had to work well with multiple users, but it also had to slightly punish single users—the idea being that a single user would want to play that game alone initially, but have difficulty as the game progressed, thus motivating them to seek out help from passersby. Secondly, the usability had to be somewhat universal, so that all types of users can play along with no major difficulties. Moreover, the game had to be intuitive to play, so that players could join in without significant instructions or considerations being necessary.

Through three days of in-the-wild testing the prototype was evaluated with regards to the frequency of SGF and the factors behind it. Our results show that 2%–15% of use instances resulted in SGF, differing between test locations. Moreover, SGF was typically initiated by users drawn to the game while another user, or users, were already playing.

2 Related Work

A variety of previous work in the area of urban installations focused on shared encounters [1,4,14,11], however only few of the observed instances resulted in a group pursuing a common goal. Willis defines shared encounters as "*the interaction between two people or within a group where a sense of performative co-presence is experienced and which is characterised by a mutual recognition of spacial or social proximity*" [20]. Schieck goes a bit further and describes *digital encounters*, defining them as "[...]*a digital encounter is an ephemeral form of communication and interaction augmented by technology*" [17]. Thus, a digital encounter is in essence a shared encounter facilitated or enhanced by technology. In our particular case we are interested in a smaller sub-set of these shared encounters, that we refer to as *Spontaneous Group Formation* (SGF). In these situations, a group forms out of several individuals or multiple smaller groups or small groups and individuals, to form one large group, that cooperates in a shared encounter, to reach a common goal.

Across multiple studies, interaction with installations in pairs or smaller groups of users, has been found to be more frequent, compared to individuals. Fischer et al. made observations over 3 different urban installations and counted how many people passed by the installations [4]. For the first installation, the Interactive Fountain, 84 percent of all people that interacted with the system

were in groups. For the Second installation, kick-/flickable light fragments, all passersby that interacted with the installation were in groups. And for the third installation, the PIPE project, 92 percent of the people that interacted were in groups. Similar observations have been made in Morrison et al., where 36 percent of 722 people in pairs and 35 percent of 489 people in groups bigger than two were observed interacting with the system, compared to 28 percent of 512 observed individuals interacting [14]. Fischer et al. also found that the Interactive fountain created shared encounters among 1 percent of the total people observed, and 3 percent of the passersby of the PIPE project experienced a shared encounter [4]. While these cases have been observed, the original goal of the discussed approaches was not necessarily to create such shared encounters. For this paper however we try to identify factors that lead to shared encounters and specifically SGM.

In line with these findings, Laureyssens et al. also found that of all people participating in ZWERM, a competitive urban participation game between two neighbourhoods, an average of 13 new acquaintances were made during the duration of the game which spanned over four weeks [11]. One of the main similarity between installations in which shared encounters have been observed is that they all have fixed interaction spaces, meaning that interaction with the installation occurs within a static space. Furthermore two of these installation also afford cooperation between multiple performers. The PIPE project featured three pneumatic pressure tubes that would sequentially light up segments of light with colors depending on which tubes were activated at the same time. The tubes were large enough to fit multiple people on one at a time, and afford cooperation between multiple people to manipulate the segments of lights. ZWERM also encouraged participation by multiple performers on both sides of the competition, since the primary objective of the game is for each team to gather as many points as possible, and some participants of this game were even observed trying to recruit other performers for that reason.

While it seems that installations with fixed interaction spaces and affordance for multiple performers at once seem to lend themselves to creating shared encounters, installations with dynamic interaction spaces that can change location can also potentially create social interaction. In their analysis of SMSlingshot, Fischer et al. also argue that the installation could serve as a gestation point for social interaction, as people would e.g. discuss what message to type or talk about the device [5]. For our we aim to create an installation that is not bound to a certain interaction space, but that rather acts universal, so this will not factor in the design of the installation.

During their study of ZWERM, Laureyssens et al. found that participants in the game would go from door to door in their neighborhood to recruit other people [11]. A phenomenon similar to that observed in Laureyssens et al., was recorded by Balestrini et al. in their study of the Jokebox, where people who were familiar with the installation would encourage passersby to try it [1]. This phenomenon has also been referred to as championing. Furthermore, in Webber et al.s study of an Interactive music installation visualizing movements of

participants, it was also observed that under instruction by performers participants were observed to enthusiastically form groups among both friends and strangers [19]. Championing, is one of the phenomena that we aim to design for in this paper, by punishing single players to some extend, that they will want to recruit more participants.

Two additional social phenomenon have also been found during the observation of public installations. One of them is called the honeypot effect, and refers to urge for passersby to participate in social interactions around the installation [21]. In the study of ZWERM, it was observed that during social gathering of performers around the installations, passersby would approach, observe and partake in the activities. Similarly, Balestrini also observed that individual passersby would be more likely to notice and observe the Jokebox if there were already people interacting with it [1]. Related to this effect is the installation design. Fischer et al. discussed that the SMSlingshot turned users into highly performative displays that would attract the attention of other passersby and this could be caused by their unusual movements [5]. Müller et al. observed this in their study of the Looking glass, where passersby would take notice of other users interacting with the system, observe the interaction and occasionally partake in it [15].

The second phenomenon that has been reported is referred to as hidden queuing. In their study of the kick-/flickable light fragments, Fischer et al. experienced groups of observers that would wait for a group of performers to finish interacting with the installation, before proceeding to interact with system themselves [3]. Similarly in Balestrini et al. it was observed that attracted passersby would also not interfere with any currently ongoing interaction with the interaction, but would rather wait until the installation was unoccupied [1].

While the honeypot effect would be preferable phenomena to achieve, it is very hard to design for, and often depending on the location [21]. On the other hand the hidden queuing phenomena is something that should be rather prevented, as it would maybe keep people from joining a group for interaction.

2.1 Designing for Group Use

When designing urban installations it is important to consider how it grabs the attention of passersby, and how wide the possibilities for interaction are. Hornecker et al. [9] describes design concepts useful in both designing and analysing interactive installations: *Entry points*, how the installation grabs the attention of potential users and invites them to engage in use of it, and *Access points*, the options and possibilities a user has for engaging in use of the installation.
Entry points are important to consider, especially with regards to the progressive lures of the system, and in how easy it is for passersby to observe, and thus learn, the installation. Moreover, considering access points and the number thereof is critical when designing an installation meant for facilitating group use, as shown by Hornecker [8]. This is especially in the case of manipulative access: the specific methods though which a user interacts with the system. So when designing an installation meant to enable and encourage SGF, making sure that

the system has multiple manipulative access points should be a core concept of the design.

3 Design

The concept for the prototype was set out to be an urban installation with the intention of creating SGF, based on the game *Simon*. This game – also known as *Simon Says*– is a memory game that shows a sequence of 4 different colours which the player then has to remember and repeat using buttons of the same colours. Each time a player successfully repeats a sequence, they are shown the same sequence with an additional colour at the end, theoretically continuing ad infinity. To encourage group play, we scaled the whole game, so that the distance between the buttons was drastically increased to up to four meter and the time limit for repeating each step of the sequence was extended to allow for SGF.

3.1 Hardware

The physical prototype is comprised of two major components: a center pyramid which displays the colour-pattern, and button towers which player's use to interact with the system.

Center Pyramid
The center pyramid is built from acrylic glass. Four equilateral triangles were laser cut and assembled to form a pyramid. Using cardboard, the inside of the pyramid was separated into four sections, and each section had paper of different colours glued to the inside of the pyramid: red, yellow, green and blue, respectively (see Figure 1). The center pyramid also contains the majority of electronics that make up the prototype.

The pyramid houses the system electronics of the prototype: a Raspberry PI 3 model B, an Arduino Micro and circuits connecting to LED lights, LED strips and the external buttons.

Button Towers
Four button towers were created for the game, one for each colour, where a button was affixed to the end of a standing pipe as can be seen in Figure 2. The intent behind these buttons was that they should be situated at lead a few meters from the center pyramid, forming a square around the it. The buttons are big coloured push buttons placed on top of the tower roughly 1 meter tall. The towers are made from PVC-U piping mounted on wooden feet, with weights in the bottom to ensure they do not fall over. The towers had to be tall enough that adults could comfortably push the buttons standing up, and they had to be short enough where children could still see and reach them. The average height of an eight year old (the recommended minimum age for the game is, according to *Sundhed.dk*, roughly 130 cm. [18], and as such a height of 1 meter enables children to play, while still being comfortable for adults.

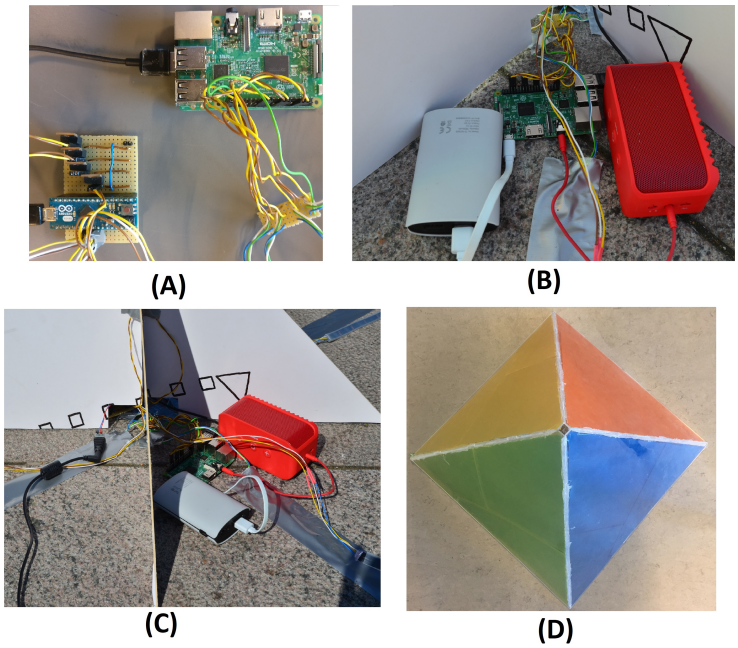

Fig. 1. (A) The Arduino, Raspberry Pi and perfboards, (B) the Raspberry pi, powerbank and speaker, (C) the setup as it look when placed by the cardboard triangle, (D) the pyramid beneath which the other components were covered.

Fig. 2. One of the button towers.

3.2 Software

The Raspberry Pi functions as the main controller for the system and handles the buttons, audio feedback, and game mechanics. When a button is pressed the Raspberry looks at the current state of the game, e.g. if the sequence is being repeated correctly or if it is a new game, and then instructs the Arduino to display the correct pattern of light in the LED strips and center pyramid, depending on the state of the game.

The feedback of the system, both visual and audible, have dual purposes. Firstly, to give the user feedback when they interact with the prototype as well as giving additional memory cues, and secondly to function as a lure to attract people's attention.

4 Evaluation

Before engaging in the main evaluation, we conducted several pre-evaluations in which the prototype was tested in a number of scenarios to identify whether there were any immediately pressing issues or misunderstandings within the design. The tests included asking users to play the game without any interference, and playing the game in high stress situations, such as with a single person. The prototype was tested with all eligible numbers of players (one to four). In these tests, users seemed to be confused in regards to the time limit between clicks, especially when they lost and they could not identify specifically why. This lead to the implementation of a tick timer that activates when a button is clicked, and starts ticking, going increasingly faster until the time has run out and the game is lost. This seemed to create a sense of urgency in the users, and would have many of them running long before necessary. Additionally, some users were in doubt as to what the goal of the game was, which led to the implementation of a introductory audio clip, that plays whenever a user presses a button to start a new game, which then explains the rules of the game to the user. These additional implementations were tested and deemed successful on a university-scheduled demonstration day, where the prototype was set up for four hours. No additional issues were identified.

4.1 Ways of Use

In order to characterize the behaviours of the users in our in-the-wild evaluation, we selected to categorize their behaviour in the following way. We define three different ways in which users interact with an urban installation are defined. These are:

Intended Use (IU) - Meaning to interact with the system in the manner which was intended by the developers as they designed the system.

Exploratory Use (EU) - Meaning to interact with the system in a curious and inquisitive manner, trying to discern the purpose behind it.

Playful Use (PU) - Meaning to play in the area surrounding the system, in a way where the system takes a role, however the function(s) of the system need not be of consequence to goals of the game being played.

When it comes to evaluating a system with respect to discerning the factors behind SGF, looking into the frequency of the different ways of use can potentially be of some assistance. A pattern might reveal itself, giving insight into why SGF occur—or why it does not, should that be the case, e.g. if a lot of PU is observed the system might not be well enough explained, hampering the possibility for SGF.

4.2 Method

The prototype was tested through unsupervised in-the-wild tests, taking place over 3 days in late April / early May. The prototype was set up at three different locations in the city of (Omitted for blind review) that each have a relatively high flow of pedestrians. Test facilitators observed the use of the prototype from a distance, and the entire test period was video recorded for observation purposes. The Purpose of the evaluation was to determine the factors behind SGF.

For the purpose of these tests, a spontaneous group formation is defined as: When 2 or more groups of people (or individuals), with no preexisting plans to meet up, interact in a manner that involves any of: playing the game together for any period of time or direct conversation, as result of, or in relation to the game.

Before testing, several elements were defined that should be observed and noted during the tests. Common for these elements was the assumption that they can help explain the factors that determine when SGF happens. The elements are:

Play time: For how long did a user play on their own before receiving help from another user?
Initiator: If spontaneous group formation took place, which person initiated the contact?
Demographic: Which demographic did the users fall under?
Loss condition: If they did, how did they lose? Timeout or incorrect sequence?

For purpose of comparison, the demographics were noted for all users, not just those engaging in SGF.

4.3 Procedure

The first test took place on the 25th of April and lasted for three hours from 11:00 to 14:00. The prototype was set up inside a university building as can be seen in Figure 3 - A, in the main hall near the cafeteria as well as near the main stairs leading to the upper floors—an area that sees a lot of thoroughfare. The idea behind choosing this test location was to try out the prototype in an area where SGF was thought likely to happen, due to the nature of the environment.

The second test took place on the 6th of May and lasted three hours from 13:00 to 16:00. The weather was sunny and warm. The prototype was set up on

the harbourfront in the shade of the same university building as can be seen in Figure 3 - B. On this day, there was a flea market on the harbourfront roughly 400 meters from where the prototype was set up, which likely increased the flow of pedestrians on the harbourfront during the test period.

Iteration

Between the second and third day of testing the setup underwent small iterations to better ensure that people understood how to interact with the prototype, in addition to better inform passersby that it was meant to be interacted with. These iterations were implemented based on observed instances of exploratory use and feedback from participants who stated that the lights were hard to see in the day, and due to the orange colour and position of the button towers, i.e placed in a square around the pyramid, it looked like the area was closed off as can be seen in Figure 3 - B. To fix this, a sign was created aimed at informing passersby how to use the prototype, and to be used as an additional entry point.

The third test took place on the 9th of May and lasted 7 hours and 30 minutes from 16:00 to 23:30. The weather was sunny and warm. The prototype was set up in a plaza, as can be seen in Figure 3 - C, close to the harbourfront as well as several pubs and restaurants, and near one of the city's larger bus stops. The pedestrian flow was markedly higher in this location than it was on the harbourfront on day two.

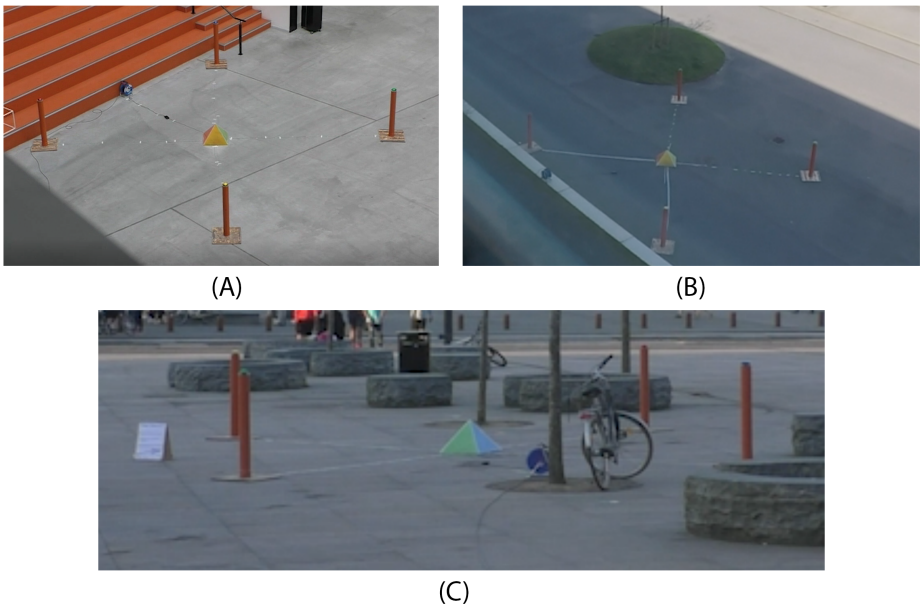

Fig. 3. Test setup on the first (A), second (B), and third (C) day.

4.4 Results

The Results of the tests are presented in two parts, first presenting the results on SGF, then results on the general observed use of the prototype.

Spontaneous Group Formation
All use cases from the tests were reviewed with respect to the definition of SGF outlined in section 4.2. Keeping this definition in mind, whether or not a case involved SGF was judged by the facilitators. If SGF seemed to occur, additional attention would be paid to whence the users respectively approached the prototype, and in which direction they left afterwards. The logic behind observing this behaviour was, that if users approached from different directions, played the game together, and then left in opposite directions, the likelyhood that a true SGF was just observed would be much higher. The video recordings were used to verify these observations. Across all three tests, 11 cases of SGF were observed.

On the first day of testing 51 use cases were observed, four (7.84%) of which resulted in SGF. In the first case a male user was playing the game alone. After 32 seconds another male user initiated contact, and both proceeded to play the game together for an additional 27 seconds, after which they were joined by a third male user (counting as two instances of SGF). The entire SGF period lasted for 1 minute and 4 seconds. In the second SGF instance a female user was playing the game alone for 32 seconds, after which 3 other female users joined the game. It is unclear who initiated the contact between the two parts. After an additional 16 seconds a fifth female user joined in (again, counting as two instances of SGF). The whole SGF period lasted for 22 seconds. The third SGF case started with a male user playing the game alone for 33 seconds, after which a female user approached him, initiated conversation and joined in the game. This instance lasted for 21 seconds. The final instance of SGF on the first day of testing started with a female user playing the game alone for 42 seconds. She was joined by another female user who initiated contact. They played the game together for 21 seconds.

The second day of testing saw less use than the first day, with just 20 observed use cases over the course of the test. Three (15%) of these interactions led to SGF. All three cases started with a group of two people (all three groups approximately 17-35 years old) being attracted to the game, and initiating use. In the first of the three cases a group of eight people (ages approximately ranging from 10 to 60+) approached the players and initiated contact, starting out with observing and later engaging in direct conversation. In the latter two cases an elderly couple (approximately 60+ years old) saw what was happening and approached the players, engaging in direct conversation. The exact duration of each of the SGF cases on day two are unknown, due to technical errors with the video capture device resulting is loss of the footage. For the same reason no other data is included from day two, and there might be inaccuracies in the age ranges of the users, as they are estimated from observer-memory rather than from video footage.

On the third day of testing a total of 90 use cases were observed, only two (2.22%) of which resulted in SGF. In the first case two children, approximately three and four years old, were engaging in PU the prototype. After about four minutes of play they were joined by two other children from two other families, approximately two and five years old. All four continued to periodically play the game over the course of half an hour.

The second SGF was the last use case of the day. Here, the test facilitators were just about to pack up for the day, and decided to play a game themselves before doing so. After playing the game for 1 minute and 37 seconds, a group of three young male users, approximately 20 years old, approached, exclaiming *"What is this?"* and *"We have to see what this is!"*, as much to each other as to the facilitators. They were quickly explained the game, and one of them joined to play it with three of the facilitators. This SGF lasted for a total of 2 minutes and 26 seconds.

Common for all but one observed case of SGF is, that it occurred while someone was engaging in IU.

General Use

Throughout the testing period, there was a total of 67 instances of IU, 73 of EU and 4 of PU, for a total of 144 interactions. The IU instances included a total of 187 people, EU a total of 136 people and PU a total of 8 people. Table 1 shows the use duration for the IU and EU instances for test one and three. Use duration for the PU was not calculated, due to the insignificant number of PU instances, nor is the use duration from day two, due to the aforementioned technical issues.

60 of the 67 cases of IU were group interactions of at least two people. The average group size across all 67 cases was 2.79.

The age of the users were estimated in four different age ranges. 0–16, 17–35, 36–60 and 60+. Table 2 shows the distribution of age ranges over instances of IU, and Table 3 shows the same for the EU instances. The first SGF case from day two is unaccounted for in Table 2, as the users in this case were split between the age ranges of 0–16, 17–35 and 36–60.

5 Discussion

During the evaluation, several points revealed themselves that require further discussion. A total of 11 SGF instances were observed. On day one, the age of the SGF users all fell within 17-35, as was expected due to the location. On day two, the age of users was more evenly split, with users from 10 to 60+ years. On the third day the users were mainly withing the 17-35 age group, although a few were 0-16. From this data, it seems that the age ranges of users who engage in SGF lean towards 17-35, however this data is possibly biased, due to the location of the first test.

As shown in section 4.4, SGF was initiated after the initial user had engaged in IU for a period of 32 seconds to 1 minute 37 seconds, with a 4 minute outlier. If these results can be trusted—which only further testing and consequently a

Table 1. Use Duration

			Time Window	Mean	Median	σ
Day One	Overall	IU	00:08–06:06	01:23	00:48	01:26
		EU	00:02–00:50	00:14	00:10	00:13
	Individuals	IU	00:11–02:26	01:00	00:24	01:14
		EU	00:02–00:50	00:13	00:05	00:15
	Groups	IU	00:08–06:06	01:26	00:54	01:28
		EU	00:03–00:32	00:14	00:11	00:10
Day Three	Overall	IU	00:08–08:48	02:45	01:52	02:23
		EU	00:02–01:52	00:28	00:16	00:27
	Individuals	IU	00:40–08:08	02:38	01:04	03:41
		EU	00:08–00:40	00:20	00:16	00:10
	Groups	IU	00:08–08:48	02:43	01:52	02:18
		EU	00:02–01:52	00:31	00:16	00:31

The *Time Window*, *Mean*, *Median*, and *Standard Deviation* of use duration from day one and three. The time format is mm:ss.

Table 2. IU Age Ranges

	0–16	17–35	36–60	60+
0–16	6	1	0	3
17–35	—	43	7	3
36–60	—	—	1	1
60+	—	—	—	1

The number of IU cases with users in each age range. On the diagonal are use cases containing only one age range. To the right of the diagonal are cases where users were from multiple age ranges.

Table 3. EU Age Ranges

	0–16	17–35	36–60	60+
0–16	10	0	6	0
17–35	—	40	3	1
36–60	—	—	10	1
60+	—	—	—	3

The number of EU cases with users in each age range. On the diagonal are use cases containing only one age range. To the right of the diagonal are cases where users were from multiple age ranges.

larger sample size could determine—they indicate that SGF does not happen until after a minimum period of time has passed, likely the time it takes for observers to realise something is happening with the game, and possibly realise exactly what that is. The numbers themselves also indicate that SGF happens within the first half or first third of the use duration (when compared with the mean in Table 1), however there is no logical reason that SGF could not happen after a longer period of time—a group of people could easily have played the game for five minutes, and then be approached by another group of people who had only just now witnessed the interaction and decided to investigate.

One thing that seems rather certain based on these tests is, that when SGF happens the initiator will most likely be the group or individual who is joining the initial users. This was the case in most of the observed instances of SGF, except for one instance on both day one and three where the initiator was unclear. As described in section 4.2, the loss conditions were observed for any losses that occurred immediately before SGF, the assumption being that the loss condition might influence a user's likelihood to invite others to play. However, every observed instance of SGF was achieved before the game was lost the first time.

Differences between locations

Day three had the lowest number of SGF instances, even through it had the highest amount of foot traffic in the area, with only two SGF instances over seven hours, compared to six and three SGF instances over three hours on day one and two, respectively. Possible reasons for this difference may include: the large amount of people in the surrounding areas, dissuading potential users from performing; more noise from the surrounding restaurants and water fountain, effectively rendering the audio lure futile; or the sunny weather obscuring the visibility of the flashing lights, making the game difficult to play. The exact reason is difficult to pinpoint.

During the first day users were also exposed as on day three, as they were in the middle of a building where all floors can look directly at them. However, unlike day three the audio was clearly audible, as the nature of the educational building is a generally low level of noise. Visibly there was no problem either, as it was inside and not in direct sunlight. The sign, in this case, was not necessary, as the people in the building know that if something is set in the middle of the main hall, it is likely an exhibit by other students with which they can freely interact, as this is something that frequently happens in the building. This knowledge does not necessarily extend to the other locations.

On the second day people had plenty space to interact, even though it was a fairly trafficked day. There was nothing unusual outside causing additional noise, and the lights were fairly clear as the prototype was never in direct sunlight. One participant, however, mentioned that without a sign, the button-towers somewhat resembled poles that were supposed to keep people away, much akin to traffic cones.

Day One Discrepancies

The first test, as mentioned in section 4.3, took place at a university building. This building is inhabited by students, such as the authors, who are possibly

more likely to play than the general populous may be. This makes the instances of SGF in this building slightly less likely to be representative of more general SGF. This is presuming that the SGF instances observed on day one are actually SGF. This is put in to question, since it is known that many people traversing the building know each other as they may have done group work together, or have been in the same classes. Therefore, there is a reasonable chance that those that in the footage appear to be engaging in SGF, may simply be a group walking scattered, with one person further ahead than the rest, or a person signalling or calling for their friends after beginning to play. Regardless, this is not possible to determine purely from the footage, and therefore, for the purpose of this paper, those of them that are not obviously coming in dispersed groups, are considered instances of SGF.

Number of SGF Instances
After these tests have been done, and a satisfactory number of people have interacted and played with the prototype, the total amount of instances is still low. This means that any generalisations made about the causal factors are not necessarily accurate, even though the number of instances of SGF may be.

Competition
The concept of the prototype made for this paper, and therefore the method of generating SGF, is based on the users' need do well—their competitiveness. The intention had been for users to work together to play the game optimally, as it is rather difficult to do on your own for extended periods of time. This proved not to be the case, as none of the users gave the impression that they partnered with other users for the purpose of reaching higher levels, but rather because the joining user was interested or drawn in by the flashing colours. This could indicate that appealing to the users competitiveness is not the way, but rather creating something that is still made for multiple people, but focus more on the lure, is. For this particular installation, a way of enhancing the lure could be to periodically have the lights display an eye-catching pattern, when the installation is not in use, e.g. in combination with the present lure-audio clip.

Normal Spontaneous Group Formation
It can be said with great certainty that groups spontaneously formed around or in the context of the prototype. What cannot be said, however, is whether this number of instances of SGF is truly larger than the average number in that area. That is to say, given that groups forming and talking about or around the prototype was considered SGF, that random groups of people may meet on an average day and talk, regardless of whether something was there made to encourage it. This could be compensated for by looking at the area of testing, and attempting to spot whether any groups form spontaneously. Another option could be to create an installation that is not made to encourage group formation, and observe whether any groups form around it regardless.

Intuitiveness
During the tests it quickly became evident that the prototype was not as intuitive as previously thought. Many users approached and push a button, but did not immediately, if at all, figure out what the flashing lights meant and indi-

cated. There are several possible reasons, such as there not being a clear enough distinction between the 'pattern phase' (where the user has to watch and memorise the pattern) and the actual 'execution phase' (where the user reproduces the pattern), and the users therefore click the buttons during the pattern phase and become confused by the system not responding, which ends in them pushing the wrong button when the game has begun, and instantly losing. Another possibility is that the tutorial audio was unclear, either in audio quality, or simply in the explanation. A likely reason however, is that we overestimated the amount of people who knew and would recognise the *Simon* game, or had experience with simple memory games of similar design.

Number of Players

The developed prototype for the most part only allowed for four players at once. Everything above that would only become inconvenient. Furthermore, the prototype could only support one playing party at a time. This means that in regards to SGF, it could not make nearly as much use of the honeypot effect as it would have been able to if it allowed for either more players or multiple parties, as users could then slowly pile on and join the activity a few at a time. This, however, is easier said than done, since the prototype developed for this paper is very unlikely to have potential to be developed in said direction.

Optimal Pedestrian Flow

It might be worth considering when it is the most likely for groups to form. Specifically in the context of pedestrian flow, as there may be an optimal band of flow where the comfortability of playing and likelihood of people being there at the same time intersects. Given the data gathered through the tests, this intersection may lie somewhere between the flow of the second day and the third day, but as we neglected to measure the flow, this band would require further testing and calculation to isolate.

6 Conclusion

When creating an urban installation meant for group use, a problem may arise where a lone pedestrian will be unable to effectively engage with the installation. A theoretical solution to this, is for the user to form spontaneous groups with other, unrelated users. Hence, this project set out to explore the prevalence of this kind of spontaneous group formation (SGF), and to identify the factors behind it.

To investigate this field, a prototype was developed based on the memory game known as *Simon*. It was designed to encourage players of the game to form groups with other pedestrians by increasing its footprint to a 5 by 5 meter square, and by implementing a timer, such that larger groups would have an advantage over smaller groups or individuals.

The prototype was tested over the course of three days, in three different locations in the city, all of which had a moderate to heavy amount of foot traffic. The test showed that SGF could indeed happen, however it did not happen equally across the three spaces. The first day of testing had 4 out of 51 use cases

result in SGF, with two of them resulting in two separate SGF instances, over the course of three hours. The second day saw 3 of 20 use cases result in SGF, also over the course of three hours. The third day, on the other hand, saw only 2 of 90 use cases result in SGF over the course of 7 1/2 hours, even though it had the highest amount of foot traffic in the area. A possible explanation is that the higher amount of foot traffic meant a higher amount of potential observers, which might have dissuaded potential users from engaging with the prototype.

The game itself was designed to encourage the initial player to seek out help in order to reach higher levels, however in the majority of observed cases of SGF, contact between parties was initiated not by the initial player, but by the people joining the game, suggesting that more effective lures is the best way to encourage SGF. No conclusions could be drawn on user demographics or playtime. Thus, if any other factors are behind SGF, they remain unknown.

References

1. Balestrini, M., Marshall, P., Cornejo, R., Tentori, M., Bird, J., Rogers, Y.: Jokebox: Coordinating shared encounters in public spaces. In: Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing. pp. 38–49. CSCW '16, ACM, New York, NY, USA (2016). https://doi.org/10.1145/2818048.2835203, http://doi.acm.org/10.1145/2818048.2835203
2. Böhmer, M., Gehring, S., Löchtefeld, M., Ostkamp, M., Bauer, G.: The mighty un-touchables: Creating playful engagement on media faÇades. In: Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services. pp. 605–610. MobileHCI '11, ACM, New York, NY, USA (2011). https://doi.org/10.1145/2037373.2037468, http://doi.acm.org/10.1145/2037373.2037468
3. Fischer, P.T., Gerlach, F., Acuna, J.G., Pollack, D., Schäfer, I., Trautmann, J., Hornecker, E.: Movable, kick-/flickable light fragments eliciting ad-hoc interaction in public space. In: Proceedings of The International Symposium on Pervasive Displays. pp. 50:50–50:55. PerDis '14, ACM, New York, NY, USA (2014). https://doi.org/10.1145/2611009.2611027, http://doi.acm.org/10.1145/2611009.2611027
4. Fischer, P.T., Hornecker, E.: Creating Shared Encounters Through Fixed and Movable Interfaces, pp. 163–185. Springer Singapore (2017)
5. Fischer, P.T., Hornecker, E., Zoellner, C.: Smslingshot: An expert amateur diy case study. In: Proceedings of the 7th International Conference on Tangible, Embedded and Embodied Interaction. pp. 9–16. TEI '13, ACM, New York, NY, USA (2013). https://doi.org/10.1145/2460625.2460627, http://doi.acm.org/10.1145/2460625.2460627
6. Gehring, S., Hartz, E., Löchtefeld, M., Krüger, A.: The media façade toolkit: Prototyping and simulating interaction with media façades. In: Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing. pp. 763–772. UbiComp '13, ACM, New York, NY, USA (2013). https://doi.org/10.1145/2493432.2493471, http://doi.acm.org/10.1145/2493432.2493471

7. Grønbæk, K., Kortbek, K.J., Møller, C., Nielsen, J., Stenfeldt, L.: Designing playful interactive installations for urban environments–the swingscape experience. In: International Conference on Advances in Computer Entertainment Technology. pp. 230–245. Springer (2012)
8. Hornecker, E.: Space and place–setting the stage for social interaction. In: Position paper presented at ECSCW05 workshop Settings for Collaboration: The Role of Place (2005)
9. Hornecker, E., Marshall, P., Rogers, Y.: From entry to access: How shareability comes about. In: Proceedings of the 2007 Conference on Designing Pleasurable Products and Interfaces. pp. 328–342. DPPI '07, ACM, New York, NY, USA (2007). https://doi.org/10.1145/1314161.1314191, http://doi.acm.org/10.1145/1314161.1314191
10. Konopatzky, P., Löchtefeld, M., Reißig, S., Schöning, J., Scholz, M., Verhoeven, P., Krüger, A.: xchase a. location-based multi-user pervasive game using a lightweight tracking framework. In: Proceedings of the Second International Conference on Fun GamesFNG. vol. 8 (2008)
11. Laureyssens, T., Coenen, T., Claeys, L., Mechant, P., Criel, J., Vande Moere, A.: Zwerm: A modular component network approach for an urban participation game. In: Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems. pp. 3259–3268. CHI '14, ACM, New York, NY, USA (2014). https://doi.org/10.1145/2556288.2557053, http://doi.acm.org/10.1145/2556288.2557053
12. Löchtefeld, M., Schöning, J., Rohs, M., Krüger, A.: Littleprojectedplanet: an augmented reality game for camera projector phones. Artificial Intelligence pp. 15–27 (2009)
13. Löchtefeld, M., Schöning, J., Rohs, M., Krüger, A.: Marauders light: Replacing the wand with a mobile camera projector unit. In: Proceedings of the 8th International Conference on Mobile and Ubiquitous Multimedia. pp. 19:1–19:4. MUM '09, ACM, New York, NY, USA (2009). https://doi.org/10.1145/1658550.1658569, http://doi.acm.org/10.1145/1658550.1658569
14. Morrison, A., Manresa-Yee, C., Jensen, W., Eshraghi, N.: The humming wall: Vibrotactile and vibroacoustic interactions in an urban environment. In: Proceedings of the 2016 ACM Conference on Designing Interactive Systems. pp. 818–822. DIS '16, ACM, New York, NY, USA (2016). https://doi.org/10.1145/2901790.2901878, http://doi.acm.org/10.1145/2901790.2901878
15. Müller, J., Walter, R., Bailly, G., Nischt, M., Alt, F.: Looking glass: A field study on noticing interactivity of a shop window. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. pp. 297–306. CHI '12, ACM, New York, NY, USA (2012). https://doi.org/10.1145/2207676.2207718, http://doi.acm.org/10.1145/2207676.2207718
16. Nijholt, A.: Towards playable and playful cities. In: Playable Cities, pp. 1–20. Springer Singapore (2017)
17. Schieck, A.F., Kostakos, V., Penn, A.: Exploring digital encounters in the public arena. In: Shared encounters, pp. 179–195. Springer (2009)
18. Sundhed.dk: Growthcurve, boys 0-20. https://www.sundhed.dk/borger/patienthaandbogen/boern/illustrationer/tegning/vaekstkurve-drenge-0-20/, last Accessed: 21-05-2018
19. Webber, S., Harrop, M., Downs, J., Cox, T., Wouters, N., Moere, A.V.: Everybody dance now: Tensions between participation and performance in interactive public installations. In: Proceedings of the Annual Meeting of the Australian Special

Interest Group for Computer Human Interaction. pp. 284–288. OzCHI '15, ACM, New York, NY, USA (2015). https://doi.org/10.1145/2838739.2838801, http://doi.acm.org/10.1145/2838739.2838801

20. Willis, K.S., Roussos, G., Chorianopoulos, K., Struppek, M.: Shared encounters. In: Shared encounters, pp. 1–15. Springer (2009)
21. Wouters, N., Downs, J., Harrop, M., Cox, T., Oliveira, E., Webber, S., Vetere, F., Vande Moere, A.: Uncovering the honeypot effect: How audiences engage with public interactive systems. In: Proceedings of the 2016 ACM Conference on Designing Interactive Systems. pp. 5–16. DIS '16, ACM, New York, NY, USA (2016). https://doi.org/10.1145/2901790.2901796, http://doi.acm.org/10.1145/2901790.2901796